

# 5 Pieces of Evidence of Climate Change: *Using Cryospheric Data*

15 November 2017

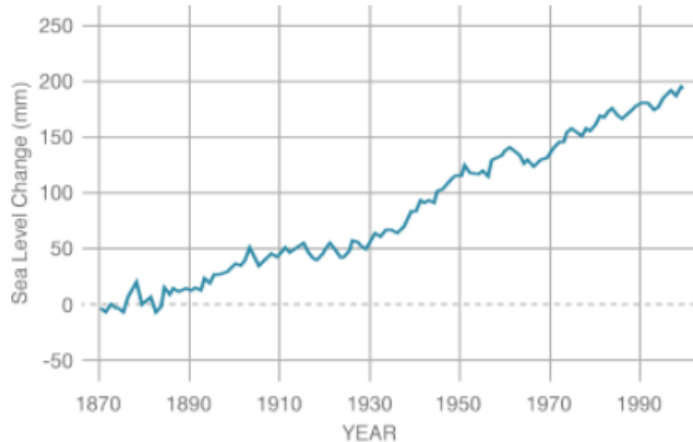
# Sea Level Rise

- <https://climate.nasa.gov/>
- Sea level rise from ~0 mm in 1870 to almost 200 mm in 2000

## Sea Level

### GROUND DATA: 1870-2000

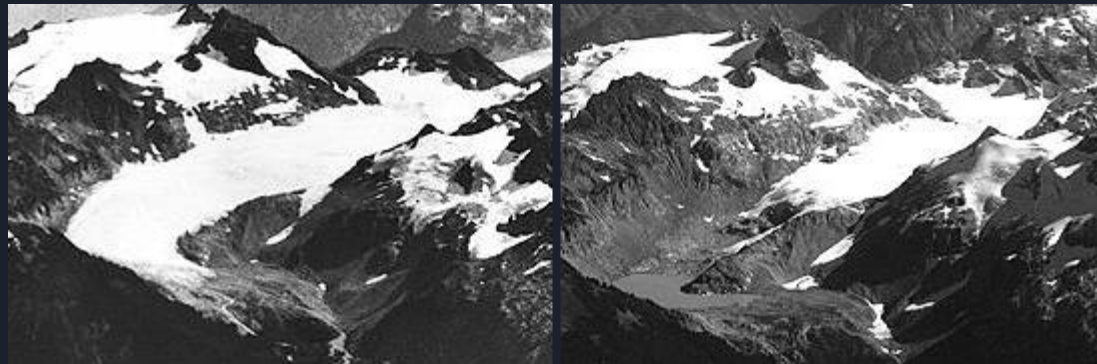
Data source: Coastal tide gauge records.  
Credit: CSIRO



Sea level rise is caused primarily by two factors related to global warming: the added water from melting ice sheets and glaciers and the expansion of sea water as it warms. The above graph, derived from coastal tide gauge data, shows how much sea level changed from about 1870 to 2000.

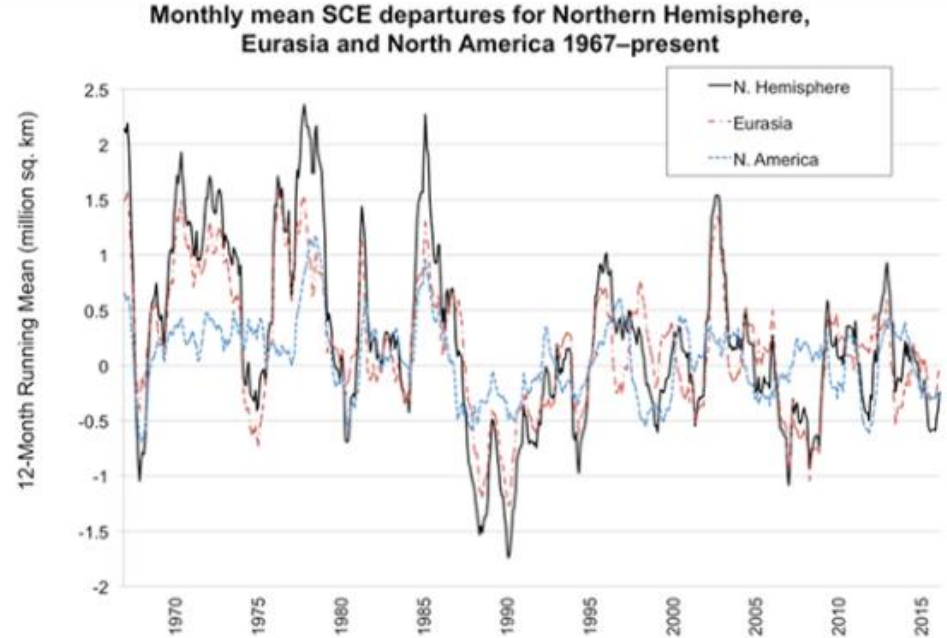
# Mountain Glacier thinning and retreating

- **1941-2004 comparison:** Glacier Bay National Park and Reserve's White Thunder Ridge as seen on August 13, 1941 (left) and August 31, 2004 (right).
- Muir Glacier has retreated out of the field of view, Riggs Glacier has thinned and retreated significantly, and dense new vegetation has appeared.
- Muir Glacier was more than 2,000 feet thick in 1941.
- 2004 USGS photo by B.F. Molnia; 1941 photo by W.O. Field. See [Repeat Photography of Glaciers](#) in the Glacier Photograph Collection to access this and other photograph pairs.
- National Snow and Ice Data Center: [https://nsidc.org/cryosphere/sotc/glacier\\_balance.html](https://nsidc.org/cryosphere/sotc/glacier_balance.html)



# Northern Hemisphere Snow Cover Extent

- “Declining snow extents are consistent with expectations for a warming climate, but another factor may also be at work. Aerosols such as dust and soot accelerate snowmelt by reducing albedo”
- [https://nsidc.org/cryosphere/sotc/snow\\_extent.html](https://nsidc.org/cryosphere/sotc/snow_extent.html)



Snow cover anomalies, 1967-2016: This graph shows snow cover extent departures from average for the entire Northern Hemisphere (solid black), Eurasia (dashed red), and North America (dashed blue). Note that the 12-month running anomalies are plotted on the seventh month, based on values from November 1966 to December 2016. Graph from Robinson 2016b and Rutgers University Global Snow Lab.

# Greenland and Antarctica loss of land ice sheet

- Data from NASA's GRACE satellites show that the land ice sheets in both Antarctica (left chart) and Greenland (right) have been losing mass since 2002.
- Both ice sheets have seen an acceleration of ice mass loss since 2009. (Source: GRACE satellite data) <https://climate.nasa.gov/>

## Land Ice

### ANTARCTICA MASS VARIATION SINCE 2002

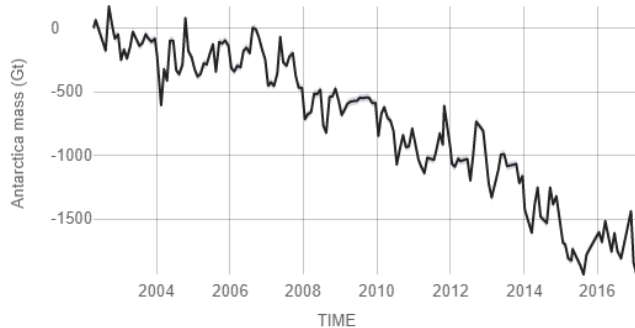
Data source: Ice mass measurement by NASA's GRACE satellites.

Credit: NASA

RATE OF CHANGE

↓ 127.0

Gigatonnes per year  
margin: ±39



### GREENLAND MASS VARIATION SINCE 2002

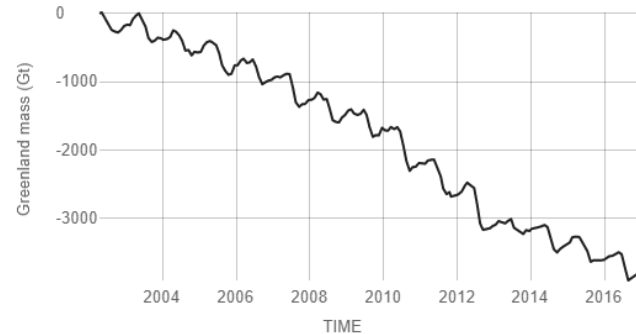
Data source: Ice mass measurement by NASA's GRACE satellites.

Credit: NASA

RATE OF CHANGE

↓ 286.0

Gigatonnes per year  
margin: ±21





- Change in Arctic sea ice coverage
- Satellite- based passive microwave images of sea ice
- NASA Global Climate Change Resources
- [https://climate.nasa.gov/climate\\_resources/155/](https://climate.nasa.gov/climate_resources/155/)